

# Shores of Strength: Nurturing Resilient Mobility in Makassar’s Coastal Embrace

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With its coastal charm and dynamic energy, Makassar stands at the intersection of tradition and modernity. While mesmerising, the tide’s flux and flow present unique challenges for this city’s transport system. As we navigate these coastal currents, a resilient mobility plan emerges as the key to unlocking Makassar’s full potential.

## Setting the stage

Nestled along its coastal plains, Makassar reveals a complex vulnerability profile. The city’s heartbeat echoes through the bustling urban flatlands within this dynamic canvas. It stands as the capital city of South Sulawesi, which lies adjacent to the Makassar Straits. Flanked by three big rivers, Tallo, Jeneberang, and Pampang, it is known as a “waterfront city.” It has a long history as an important port and transit point (Fleming, 2021). Its strategic position offers rich and unique potential to the East of Indonesia.

This advantageous position contributes to the economic development of the communities in Eastern Indonesia. The development plan for Makassar is outlined in Presidential Regulation Number 55 of 2011 concerning the Spatial Plan for the Urban Areas of Makassar, Maros, Sungguminasa, and Takalar. The document describes Makassar as the core urban area in Mamminasata, serving various essential functions. It is designated as an international, national, and regional trade and service centre, a hub for public passenger and regional freight transportation systems, a focal point for tourism activities, and a centre for international and national maritime transportation services. This is facilitated by the presence of the Paottere Port in Makassar, which serves as a key hub for ferry transportation, connecting Mamminasata Urban Area with residential centres on Sulawesi Island and other islands, as well as a hub for maritime tourism activities in the small islands surrounding Makassar.

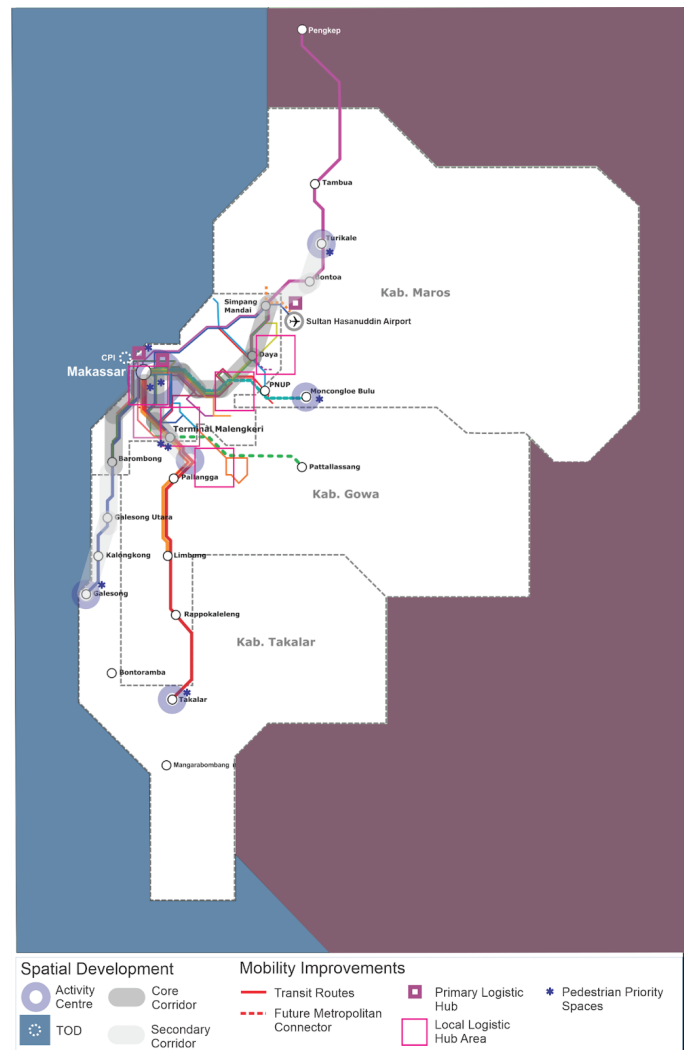


Figure 1. Sustainable Urban Mobility Planning Strategy  
Source: MMA Sustainable Urban Mobility Scenarios and Strategy, 2022

However, the scenic diversity conceals a vulnerability that demands our attention. Examining Makassar’s 36.1 km coastline through the lens of the Coastal Vulnerability Index unveils a nuanced vulnerability profile.

Approximately 25.4 km of Makassar's coastline grapples with a moderate vulnerability level, while around 10.6 km forms a more resilient, low-vulnerability area, constituting just 30% of the coastal expanse (Nur et al., 2021). In addition, as outlined in the Urban Spatial Planning Plan for the Makassar, Maros, Sungguminasa, and Takalar regions (Presidential Decree No. 55/2011), five sub-districts in Makassar fell under Zone L4 and categorised as flood-prone areas. This adds another layer to the city's challenges.

Compounding this challenge is the notable flood hazard, where approximately 38.6% of the total area and 42.4% of the population face exposure. The estimated annual loss due to flood damage, a staggering IDR 2.7 trillion (about USD 190 million), underscores the economic urgency and human impact of these natural phenomena (Indrayani, et al., 2023). Recent events on December 26, 2022 demonstrated the city's vulnerability as floods engulfed around 1,000 houses, affecting sub-districts such as Manggala, Biringkanaya, and Tamalanrea (Fatir, 2022). In response, swift actions by local authorities involved the deployment of personnel and equipment, orchestrating evacuations to safer locations. Makassar's Mayor, Moh. Ramdhan Pomanto characterised last year's floods as the most severe and widespread, highlighting the urgency for a resilient response (Rustam, 2022). The biggest impacts, such as the inundation of two large hotels and a shopping centre in Ujung Pandang Sub-district alongside the damage to several bridges and roads, underscore the far-reaching consequences of these events. Below is the map showing flood-prone areas in Makassar City.

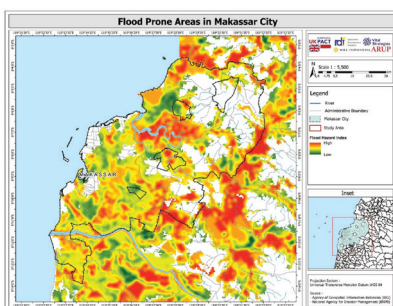


Figure 2. Flood Prone Areas in Makassar City

Source: inaRISK National Agency for Disaster Management, 2023

The consequences of bridge and road damage naturally impede the community's mobility. Survey results show that it is evident that while the community has demonstrated active participation in recent election processes, their involvement in the planning process and support from non-governmental partner organisations are still deficient. In several instances, the community has consistently reported environmental conditions, such as deteriorating roads or insufficient drainage, yet these concerns remain unaddressed. The government's incapacity to rectify these infrastructure issues contributes to heightening vulnerability, particularly during disasters.

As Makassar struggles with the formidable challenges posed by coastal erosion, high waves, and recurrent floods, the intricate relationship between its coastal condition and urban resilience becomes evident. The dynamics of these natural forces put the city's infrastructure at risk and extend their impact on the very fabric of daily life. As we traverse the complexities of coastal vulnerability, this delicate interplay sets the stage for a broader exploration into the implications for urban mobility in Makassar. How does the city's unique coastal landscape shape the challenges the overall transportation infrastructure faces? This question forms the bridge between the coastal condition's immediate threats and the cascading effects on urban mobility, urging us to delve into the interconnected tapestry of challenges and responses that define the city's future.

### **Unravelling the impact of coastal challenges on urban mobility**

The coastal challenges in Makassar create a dynamic backdrop, influencing how people move through the city and revealing the intricate dance between urban mobility and the ever-changing coastal environment. The inadequacy of existing bus stops becomes glaringly evident, with issues ranging from limited distribution to maintenance challenges, including broken benches and scattered garbage.

Safety concerns are amplified as these stops lack facilities for individuals with disabilities and adequate lighting. Similar deficiencies extend to the Pete-Pete, Makassar's primary mode of transportation, where subpar bench and cooling conditions, cleanliness, and maintenance persist. Compounding the problem is the absence of stringent regulations governing operational permits, allowing outdated vehicles to operate, thus compromising overall safety. Particularly alarming is the reported low sense of safety for women, who are the majority of public transportation users, further eroded by incidents of harassment within Pete-Pete. The assessment of pedestrian facilities highlights damaged sidewalks blocked by street vendors, leading to increased discomfort in the community.

Furthermore, the disruption of community movement patterns during disasters, especially floods, underscores the vulnerability of crucial infrastructure, including roads, bus stops, ports, and terminals. Activities essential for the daily rhythm of the community face potential halts due to transport infrastructure being rendered impassable or disrupted by floodwaters. This is evident from flood reports in Makassar in February 2023, as highlighted by Mappong (2023) in *Antaraneews.com*, where the floods impeded road access, including to schools, prompting the Department of Education to instruct school closures.

Additionally, as reported by Arman (2023) in *Kompas.id*, major roads, residential streets, and even toll roads were inundated in Makassar. In some residential areas, the water reached up to one metre in height, leading to many drivers getting stranded and some vehicles malfunctioning due to immersion. Roads like those around Pantai Losari, Jalan Pettarani, Boulevard, Gunung Lompobattang, Gunung Bawakareng, Sungai Saddang, and Cendrawasih were flooded. The Trans-Sulawesi road in Perintis Kemerdekaan and Urip Sumoharjo was also affected.

An overlay analysis examining transport elements such as roads, bus stops, ports, and terminals in conjunction with indicative flood hazard locations revealed vulnerabilities in the city's infrastructure to flooding. The analysis identified roads susceptible to high flood risks, with 14.71 km (6.14%) of highways and 85.97 km (35.83%) of primary roads falling within high flood hazard zones (RDI, 2023). Roads in these areas can potentially disrupt people and goods movement during flood events. Critical infrastructures, including eight ports, one terminal, and 39 BRT stops, were also identified as vulnerable. BRT routes within high-risk areas, such as the internal Ujung Pandang area route K1M and the route to the Untia Sub-District K3M, experience frequent operational disruptions due to water puddles (Lallo, 2023 in *RakyatSulsel*).

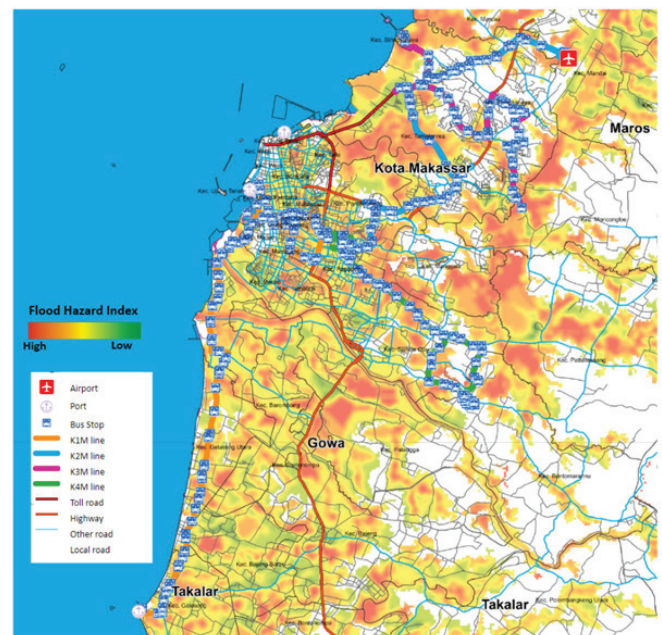


Figure 3. Overlay map of transportation infrastructure and flood hazard areas in Mamminasata

### A response to the urban mobility resiliency condition in Makassar

In the face of challenges, Makassar is poised for more than recovery—it aims to construct a thriving city amidst coastal adversities. Resilience in urban mobility demands a multifaceted response, extending beyond recovery to a transformative approach.

As we embark on this journey, several key pillars emerge, contributing to the city's ability to withstand future shocks and flourish within the embrace of its coastal landscape.

### **1. Infrastructure reinforcement**

Investing in resilient infrastructure forms the bedrock of Makassar's response to urban mobility challenges exacerbated by coastal conditions. Beyond mere restoration, this entails strategic improvements considering the dynamic interplay between coastal forces and the city's transport systems. Elevating roads, fortifying critical infrastructures, and implementing innovative flood-resistant designs become imperative steps.

A good example is coming from Copenhagen. According to the OECD (2018), sudden heavy rainfalls are predicted to become more severe in Copenhagen. Thus, these steps need to be developed and refined, e.g., property-level measures, including anti-backflow valves to prevent sewer water from entering basements; green space and waterway restoration, facilitate the flow of the water and provide additional amenity value; grey infrastructure, builds a tunnel to enhance drainage capacity in heavily built-up areas and roads are to be redesigned. Therefore, it can be used to channel excess rainfall to the sea.

Urban mobility challenges in Makassar, such as damaged roads and vulnerable bus stops during floods, necessitate infrastructure reinforcement. For instance, elevating critical roadways in flood-prone areas, including those identified in the overlay analysis, ensures they remain passable during extreme weather. Reinforcing bus stops with flood-resistant designs, elevated platforms, and improved drainage addresses the vulnerability of these essential transport nodes.

### **2. Nature-based solutions (NBS)**

In navigating the complex challenges posed by coastal vulnerabilities and frequent floods, exploring innovative solutions becomes imperative.

A significant contribution to this discourse comes from the research conducted by Debele et al. (2019) on managing flooding across Europe. Their findings shed light on a nuanced landscape where a hybrid approach, incorporating elements like rain gardens and green roofs, emerges as a leading strategy, managing 23% of the flooding instances. Complementing this, the green approach, constituting 20% of the flooding instances, showcases its effectiveness in flood reduction. Of particular note is the role of hybrid methods in safeguarding coastal zones from floods generated by storm surges, emphasising its pivotal position at 9.3%. As we delve into these findings, we uncover promising avenues for integrating Nature-based Solutions, specifically focusing on the hybrid approach, in fortifying Makassar's resilience against its coastal challenges.

In response to the challenges posed by recurrent floods, integrating bioswales along key transportation corridors like Pettarani Boulevard becomes crucial. With their ability to manage stormwater runoff, bioswales address the flooding of roads and bus stops. Specifically, bioswales strategically placed in high-risk flood areas identified in the analysis contribute to reducing flood hazards while enhancing the city's green infrastructure.

### **3. Community engagement**

Educating the community about disaster risks and sustainable transportation choices directly addresses challenges related to the inadequacy of existing bus stops, safety concerns, and a lack of awareness. Workshops and campaigns can highlight the importance of sustainable modes of transportation, fostering a sense of responsibility among residents for maintaining clean and accessible transportation infrastructure.

### **4. Technological integration**

In the age of smart cities, technological integration stands as a powerful tool, enhancing urban mobility amidst coastal uncertainties.

Intelligent traffic management systems, real-time flood monitoring, and advanced communication networks empower the city to respond promptly and efficiently to emerging challenges. This embrace of innovative technologies enhances the efficiency of transportation systems, situating Makassar at the forefront of resilient urban mobility, ready to dynamically adapt to the coastal conditions that define its landscape.

Technological integration becomes pivotal in the face of challenges like disrupted BRT routes due to water puddles and operational issues during floods. Intelligent traffic management systems and real-time flood monitoring technology can help reroute BRT routes dynamically, minimising operational disruptions. This ensures a more adaptive and efficient urban mobility system that responds swiftly to coastal challenges.

## 5. Crisis communication

Building resilience extends beyond mere preparation; it lies in a community's response to crises. Establishing reliable crisis communication channels becomes crucial, facilitating smooth coordination between authorities and residents during emergencies. Effective communication, encompassing early warning systems and community drills, nurtures a collective response that mitigates the impact of disasters on urban mobility. Through the creation of a seamless information network, Makassar lays the groundwork for resilience, robust enough to withstand the trials posed by coastal challenges.

Challenges related to disruptions in community movement patterns during disasters, particularly floods, underscore the importance of effective crisis communication. Leveraging technology, such as a mobile app for real-time alerts and community drills, addresses safety concerns and facilitates smooth coordination between authorities and residents. This ensures a collective and informed response, minimising the impact of disasters on urban mobility.

## Conclusion

In tracing the contours of Makassar's urban mobility resilience, the city unveils a story of adaptation, challenges, and transformative solutions. The coastal condition, marked by erosion, high waves, and floods, sets the stage for Makassar's resilience journey.

As Makassar manoeuvres the intricate currents of its coastal embrace, the challenges faced by urban mobility become apparent. From inadequate bus stops to the vulnerabilities of the Pete-Pete system, the city grapples with the complex interplay of coastal dynamics and transportation infrastructure. The vulnerabilities extend beyond roads and bus stops, encompassing critical ports, terminals, and BRT routes, highlighting the interconnectedness of urban mobility and coastal resilience.

However, amidst these challenges, Makassar stands resilient, shaping a future where every aspect of its existence harmonises with the dynamic rhythm of its coastal embrace. The synthesis of responses forms a holistic approach, mitigating the impact of coastal disasters and fortifying the city for sustained growth. In this forward-looking narrative, Makassar emerges as a visionary model, demonstrating how integrated solutions can propel urban mobility toward a thriving future.

Makassar's journey is more than a response to adversity; it is a declaration of resilience, a commitment to shaping a future where the vibrant rhythm of coastal life converges seamlessly with the pulse of urban mobility. The city becomes a beacon, illuminating the path towards progress anchored in resilience, a path other coastal cities may look to as they navigate their dynamic challenges.

### Disclaimer

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